Space Weather Technical Forecast

Issued on Thursday, 19 May 2022 at 13:16 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1-R2 Radio Blackouts likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has remained Moderate over the past 24 hours, with a trio of M-class flares observed at GOES16 in the period. The largest of these was an M5.6 from the vicinity of rapidly-developing AR3017 in the northeastern quadrant at 19/0719UTC. This was flanked in time by an M1.1 flare from AR3014 at 18/2202 UTC, and an M3.3 at 19/1009UTC from this same region. All the above came on a solidly and slightly intensifying C-class background, with frequent more minor flares observed, mainly from the aforementioned regions.
There are now up to nine sunspot regions on the Earth-facing side of the sun, with six numbered. Of the numbered groups, AR3014 dominates in terms of overall area and nominal complexity, with slight proliferation and areal growth in its trailing group. This feature has tenuous candidates for Mt Wilson delta spots within, and is designated as a Beta-Gamma-Delta, while its Zurich class remains Ekc.

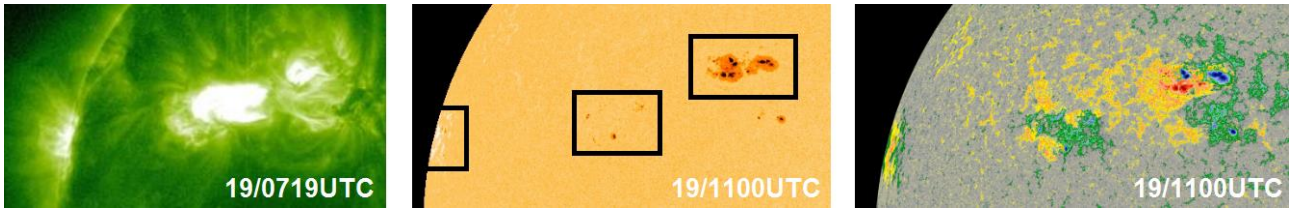

Figure 0: Left to right: AIA 094 imagery of the peak flare in the period; the three most active 'regions' on the sun in HMIIF, respectively 'NEW', AR3017 and AR3014 from left to right; and HMIBC imagery of the same region of interest.

To the east of the above group is a possible successor for most active region(s), perhaps indicating some shift in the underlying 'hot spot'. A minor disturbance in a filament to the southwest of this area around 19/0500UTC preceded the M5.6 flare from near AR3017 (visible in Udaipur H-Alpha imagery for the period). The exact partition of this group is in flux, possibly forming up to three distinct regions with apparently separate growth trends, or possibly forming one larger entity within a loosely-connected plage. The southern and western portions of this larger area of the sun saw a rapid growth trend in the past 24 hours, emerging from plage but with this trend stalling with the crowning achievement of the M5.6 flare.

Other regions on the disc were less notable, with a stable or decaying trend evident for the most part - to the extent that 2018 faded entirely from the disc. In the far northeast, there are suggestions of a new sunspot group arriving over the limb, possibly the third most active region on the disc at present, but with no M-class flares observed, and with the narrow viewing angle only suggesting a Dro/Beta at present.

Despite the large flares in the period and the possible filament lift-off seen on Udaipur imagery, no notable dimmings or Radio bursts were observed and no Earth-directed Coronal Mass Ejections

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(CMEs) have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1 was perhaps indicative of vestigial influence from a waning coronal hole fast wind from CH81, although most measures stabilised in the period. The solar wind speed averaged near 475km/s with a roughly level trend and a rough departure of +/-50km/s. The solar wind density was near the long-term average of single figures ppcc, while the IMF was within background with a peak of +7nT and a north-south component varying between +7 and -6nT. The phi angle was mainly positive (away from the sun).

The net result of the above solar wind measures was mainly Quiet geomagnetic indices, but with a provisional Unsettled peak of 3o in the 00-03UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours.

The high energy electron flux (greater than 2 MeV) has remained mostly at Normal Background levels, with the corresponding electron fluence well below the Active (1e8 integrated pfu) threshold on gentle rising, then level trend. Observed fluence at 19/0001 UTC was 2.35e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Likely to be Moderate, with a Slight Chance of an isolated Strong-class flare (R3 Radio Blackout).The main source of activity is expected to be the northeast quadrant in general, with AR3014 now seeing competition from AR3017 and perhaps also an arriving region over the limb.

Solar Wind / Geomagnetic Activity: A weak CME was observed which could have originated from AR3015 at 17/0510 UTC. This has been assessed as most likely passing behind Earth's orbit on 20 May, but may give a glancing blow but with very low confidence.

Slightly elevated to elevated solar winds are expected to persist through much of the period, as further coronal hole influence is anticipated from CH82.

Geomagnetic activity is forecast to increase to Unsettled to Active with a Slight Chance of a G1/Minor Storm interval, due to the fast wind arrival of CH82, most likely on day 1 (Thursday 19 May). Conditions should very gradually revert to become more reliably Quiet later in the UTC weekend.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period, but with a Slight Chance of flux reaching above S1, should any notable flares occur.

The high energy electron flux (greater than 2 MeV) is forecast to remain at Normal Background levels at first, but may rise over the next few days, with an increased chance of the diurnal peak reaching High levels later in the period due to fast wind effects. The 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold during the forecast period, but with a likely rising trend.

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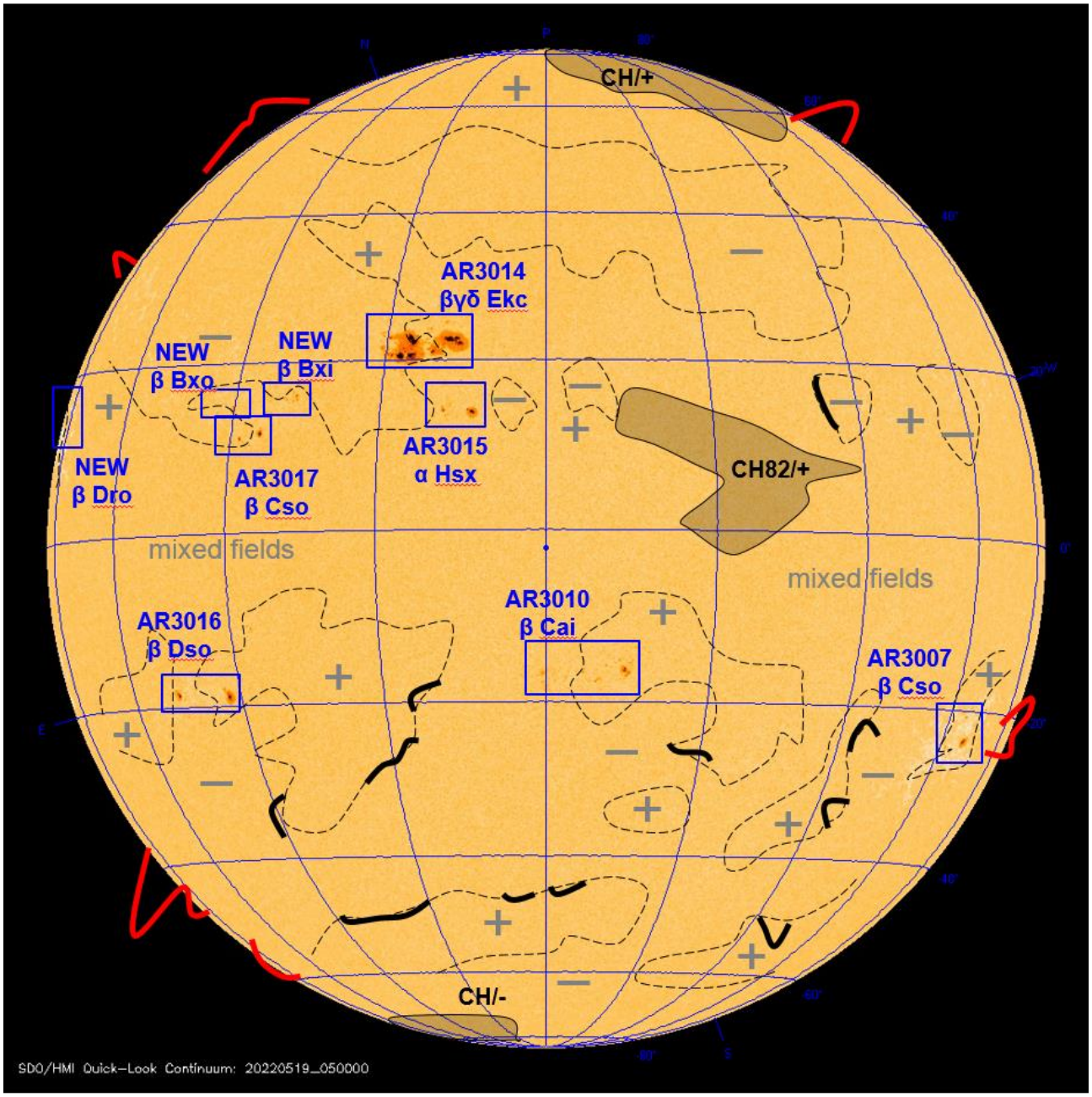
Figure 1. Solar Analysis Valid 19/0500UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A weak CME observed in coronagraph imagery during 17 May could have originated from AR3015 at 17/0510 UTC. This has been assessed as most likely passing behind Earth's orbit on 20 May, however the assessment of the CME was difficult and confidence is very low. As such, there is just a very slight chance of a glancing blow from this feature on day 2 (20th), although this is unlikely to have a significant influence on the geomagnetic forecast.

Solar winds have eased erratically due to the waning influence of coronal hole 81. However, CH82 is expected to soon arrive, leading to slightly elevated to elevated winds persisting through much of the period. This is an equatorial hole, appearing stronger and significantly more westward extended than on the previous rotation, suggesting a more notable enhancement than observed 27 days ago.

Geomagnetic activity is forecast to increase to Unsettled to Active with a slight chance of a G1/Minor Storm interval, due to the fast wind arrival of CH82, most likely on day 1 (19th). Thereafter, largely Quiet to Unsettled conditions, with a slight chance of Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	15	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

A weak CME emitted 17 May 17/0510 UTC may deliver a glancing blow on day 2 (20th).

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Radio Blackouts - X-Ray Flares:

Solar activity has remained Moderate over the past 24 hours, with a trio of M-class flares observed at GOES16 in the period. These flares emanated from two different sources (AR3014 and AR3017), with some contribution at C-class from yet another region still further east on the northeastern horizon. The fact that activity is becoming more intense and more equally partitioned is part of the rationale for slightly increased probabilities relative to earlier guidance, matching the suggested raw values from the Zurich classes of all the constituent spots.

There are also two bright flux regions evident on STEREO A EUVI imagery which are close to the northeast and southeast limbs at present. These are likely indicative of further regions due to rotate onto the disc in the coming days.

All considered, solar activity is Likely to be Moderate, with a Slight Chance of an isolated Strong-class flare (R3 Radio Blackout).

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	75	75	75	75
Very Active	R3 to R5 X Class	No	15	15	15	15

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is expected to remain at that level through the period. However, there is a slight chance of an S1 or greater event during the forecast period. This is partly due to AR3007 as it transits towards the western limb of the visible disc, however the main risk is increasingly from AR3014. This large active region has seen its complexity increase during the last 24 hours, bringing an increased chance of M-class or greater flares.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO is currently at background to moderate levels, but may rise over the next few days due to further coronal hole influences from CH82. This may give a chance of flux levels reaching High (1000 pfu) levels later in the period.

The corresponding electron fluence is expected to show an upward trend through the period, however on balance will most likely continue below the Active (1e8 integrated pfu) threshold. This is reflected by current REFM output, although this is currently trending too high on day 2 and 3 (20th and 21st).

GEO Electron Environment	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	1	5	10	30
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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